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**INFORMATION
BULLETIN**

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**U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FISH AND WILDLIFE SERVICE
GEOLOGICAL SURVEY**



**Information on
WATERFOWL
PROTECTION PROGRAM
AT KESTERSON RESERVOIR**

**U.S. Bureau of Reclamation
San Luis Unit
Central Valley Project
California**

November 1984

THE SAN LUIS UNIT SPECIAL STUDY--AN OVERVIEW

In 1960, Congress authorized construction of the San Luis Unit of the Federal Central Valley Project. The San Luis Unit was authorized to supply water and also to provide agricultural drainage service to dispose of subsurface drainage water from the lands within the unit. The Bureau of Reclamation completed part of the San Luis Drain and the first stage of Kesterson Reservoir. In 1975, construction was stopped and technical studies began to determine a final discharge point and define requirements to meet State water-quality standards. The present drain serves approximately 8,000 acres and terminates at Kesterson Reservoir, which was planned as a regulating reservoir but is now used as evaporation ponds. The Bureau is now conducting the San Luis Unit Special Study to define a plan to complete drainage facilities for the unit and the adjoining Delta-Mendota Canal Service Area.

For many years, both the State and Federal governments have recognized the need for a drainage and salt management program in the San Joaquin Valley. Various drainage alternatives were evaluated between 1975 and 1978 by the Interagency Drainage Program (IDP), a joint study conducted by the California Department of Water Resources, the State Water Resources Control Board, and the Bureau.

The IDP report concluded that the export of saline drainage water from the valley through a master drain for disposal in the western Delta estuary was the most economical and environmentally acceptable solution. Following the IDP report, the Bureau began proceedings to obtain a permit from the State Water Resources Control Board to discharge drainage to the estuary near Chipps Island. In 1981, the board established conditions for obtaining a discharge permit, and the Bureau began a 3-year study to satisfy the board's information requirements. The Bureau will soon request requirements for permits for other drainage alternatives now being examined.

Most of the technical studies required by the State board had been completed when the U.S. Fish and Wildlife Service (FWS) discovered high incidences of death and deformities among bird chicks and embryos at Kesterson Reservoir in 1983. High levels of selenium found in the drainage water in the reservoir are considered the most likely cause of these problems.

Following the findings at Kesterson, it became obvious that additional studies were needed to determine where the selenium originated and to see if it was widespread in the San Joaquin Valley or restricted to certain areas. Studies were also needed to answer many questions about the various chemical forms of selenium and their effects on the environment.

The FWS, U.S. Geological Survey (GS), and the Bureau have established a cooperative study program that will address technical issues about toxic effects from trace elements such as selenium. Studies will determine not only what levels of selenium will protect identified beneficial uses, but also possible methods of removing selenium from the drainage water if predicted levels exceed safe levels.

Until long-term solutions can be developed, the Bureau and the FWS are taking interim measures to minimize waterfowl exposure to available selenium in Kesterson Reservoir. These measures include hazing to keep waterfowl away from the reservoir and improvement of existing, nearby habitat to offset the loss of habitat to birds displaced from the reservoir.

The Bureau has extended the time to conduct the San Luis Unit Special Study to address the drainage alternatives in light of the information on selenium. The alternatives identified to date for evaluation follow four basic concepts: (1) Land disposal, (2) river discharge, (3) estuarine discharge, and (4) ocean discharge. Specific alternatives within these concepts will include the reduction or elimination of water deliveries to the lands that contribute high levels of selenium or other drainage water contaminants. An alternative of no action will also be assessed for comparison with the others. Additional alternatives identified in public meetings will be added to those now under consideration.

At the conclusion of the study, the Bureau will present the results in a Special Report and Draft Supplement to the Final Environmental Statement for the San Luis Unit of the Central Valley Project in California. The report will evaluate the expanded number of alternatives for treatment of agricultural drainage and salt management problems in the study area and compare the environmental effects of all the alternatives evaluated. The Bureau expects it may take about 4 years to complete the expanded study.

Dear Californian,

We have prepared this information bulletin--the fourth in a series--to present the waterfowl protection program recently initiated at Kesterson Reservoir. The bulletin discusses measures being considered and actions under way to minimize exposure of waterfowl to high levels of selenium and other trace elements present in drainage water stored in the reservoir.

The FWS has determined that the high incidences of mortality and deformities observed in bird embryos and newborn of birds nesting at Kesterson Reservoir in 1983 most likely were the result of a high selenium concentration in agricultural drainage water stored in the reservoir. In addition, the FWS has identified selenium poisoning as the cause of death in adult birds in 1984.

We do not know at this time how a brief exposure to the water in Kesterson would affect migratory waterfowl. However, until we can determine what the effects might be, or until we can develop a long-term solution to the selenium problem, we have initiated interim precautionary measures to avoid any potential effects on the large populations of migratory birds that use the area. This bulletin presents the actions under way to keep waterfowl and other wildlife from using Kesterson Reservoir and to safeguard the public from any potential health hazard from

eating birds exposed to the selenium concentrated in the reservoir.

Previous bulletins in this series provide additional background. Bulletin 1, published in January 1984, describes the drainage and salt management problems on the west side of the San Joaquin Valley. Bulletin 2, published in February 1984, explains the selenium problem in more detail and describes the nature of this trace element and the studies being done to identify solutions. Bulletin 3, published in August 1984, is a status report on the San Luis Unit Special Study, which the Bureau is doing to evaluate alternatives to the overall drainage problems in the area.

The coordinating agencies--Bureau, FWS, and GS--will hold meetings and workshops periodically during the study. Public involvement will be sought on the evaluation of alternatives, study results, and specific issues and concerns. Other information bulletins will also be prepared throughout the study. You will receive meeting notices and future bulletins if you were on the mailing list for this bulletin.

We encourage public participation in the important decisions to be made. Please take the time to complete the feedback form at the end of this bulletin to let us know your views.



SAN JOAQUIN BASIN

WHAT IS KESTERSON RESERVOIR?

Kesterson Reservoir consists of 12 shallow ponds with a total water-surface area of about 1,200 acres and an average depth of about 4 feet. The Bureau designed it to regulate flows in the San Luis Drain, a canal that was originally planned to discharge to the western Delta at Suisun Bay. The partially completed drain ends at Kesterson Reservoir, which the Bureau is using to store and evaporate agricultural drainage water from about 8,000 acres near Mendota.

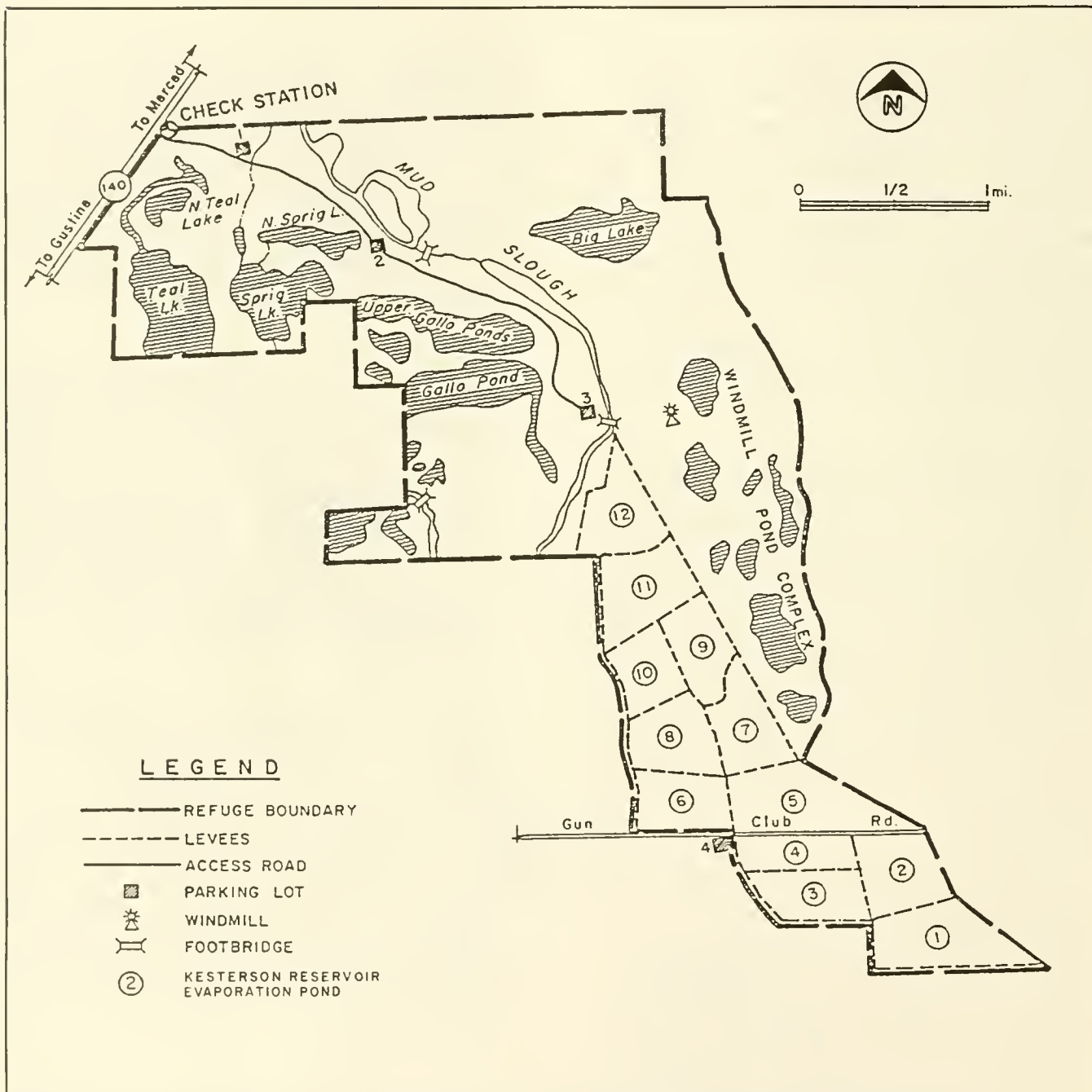
Kesterson Reservoir is just east of Gustine at the northern end of an area commonly known as the grasslands. The grasslands are mainly marsh and pasture lands in the flood plain of the San Joaquin River and provide important wintering habitat for waterfowl on the Pacific flyway. The San Joaquin River divides the lands into the east grasslands, which covers about 45,000 acres, and the west grasslands, which includes about 64,000 acres.

The majority of the grasslands are owned or leased by private citizens who have an interest in waterfowl hunting and have organized themselves into duck clubs. Over 200 clubs have been organized in the west grasslands and over 45 in the east grasslands. Many private landowners graze cattle on their lands in the spring and summer and flood the lands in the winter to attract waterfowl

for hunting. The FWS has easements on about 24,000 acres in the area to help assure the perpetual protection of waterfowl habitat. About 15,000 acres is included in the U.S. Department of Agriculture's water bank program, which is designed to keep lands flooded through mid-July to provide waterfowl food and nesting habitat.

Much of the west grasslands is included in the Grassland Water District, which borders Kesterson Reservoir on the south and west. Grassland Water District is the largest water district in the area and provides water to individual landowners for spring and summer irrigation of pasture and winter flooding for waterfowl habitat and duck hunting.

In 1968, the Bureau acquired 5,900 acres of land in the grasslands area to establish Kesterson Reservoir as part of the San Luis Unit of the Central Valley Project. The Bureau designed the reservoir for construction in two stages, or phases. The first stage was built in 1970. The second stage was to consist of 39 ponds on about 4,000 acres. Today the lands not developed into ponds are in native grasslands and seasonal wetlands.



KESTERSON NATIONAL WILDLIFE REFUGE

HOW DID KESTERSON COME TO BE PART OF A WILDLIFE REFUGE ?

Agricultural drainage is an important source of water for wetlands and wildlife management areas on the west side of the San Joaquin Valley. The FWS was interested in the development of Kesterson Reservoir because it would provide a permanent wetland area that could support a variety of fish and wildlife species.

After the Bureau acquired the 5,900 acres for Kesterson Reservoir, the FWS asked the Secretary of the Interior to designate the area as a national wildlife refuge. Under provisions of the Fish and Wildlife Coordination Act, the Secretary approved a general plan in 1969 between the FWS and the Bureau to make these Federal lands available to the FWS for the management of wildlife resources, subject to the main purpose of the reservoir for the regulation of drainage water. In 1970, the Bureau transferred to the FWS, under a cooperative agreement, responsibility for operating the reservoir and remaining 4,700 acres for the conservation and management of wildlife. In April 1982, the Bureau reassumed responsibility for the management of reservoir water levels so that it could do seepage studies of the area.

WHAT IS THE PATTERN OF BIRD USE AT KESTERSON RESERVOIR?

The San Joaquin Valley supports a resident waterfowl population of 100,000 and a large but unknown number of other birds. The peak migratory waterfowl population is about 1.7 million. In past years, the FWS estimated the spring and summer population at Kesterson Reservoir to be about 600 waterfowl (mainly mallards, gadwall, cinnamon teal, and coots). The greatest use of the reservoir has been in the spring, when large numbers of migratory birds rest and feed before returning north to their breeding grounds. Local birds and migrants from the coastal areas to the west move into the area in the spring to nest.

Migratory waterfowl nest in the summer in northern areas such as Canada and Alaska and winter in California and Mexico. These waterfowl (mainly pintail ducks) generally start arriving in the grasslands area in the second week of August and depart to return to their breeding grounds by the first week of April, depending on weather conditions.

Waterfowl that arrive in August and September tend to seek out the permanent marsh areas of Kesterson National Wildlife Refuge and the nearby Volta Wildlife Management Area, which the California Department of Fish and Game (DFG) floods in late summer to provide habitat for early migrants. Near the end of September, the duck clubs in the grasslands area flood their lands with a mixture of irrigation return flow and good quality irrigation water delivered from the Sacramento-San Joaquin Delta. The flooding attracts waterfowl during the hunting season, which extends from late October to late January. The water also provides habitat for shelter and food.

During the hunting season, waterfowl seek out areas closed to hunting, such as those on many of the wildlife refuges. After the hunting season is over, many of the duck clubs drain their lands to graze cattle in the spring and summer. During late winter and the spring, Kesterson Reservoir is one of the few large water areas left in the valley. Therefore, the bird use of the reservoir has been quite high during this period.

WHAT IS THE PROBLEM AT KESTERSON FOR WILDLIFE ?

Between 1972 and 1978, the water discharged into Kesterson Reservoir consisted mostly of surface water from local sources. Its quality was similar to that of applied irrigation water. Increasing amounts of drainage water began flowing into the reservoir in 1978 as farmers installed subsurface drains and discharged the drainage water into the San Luis Drain. Since 1981, the flows into Kesterson Reservoir have consisted of subsurface agricultural drainage water.

Prior to 1981, the San Luis Drain and Kesterson Reservoir contained several species of warmwater fish, including striped and largemouth bass, catfish, carp, and mosquito fish. All but the salt-tolerant mosquito fish began to die out as increasing amounts of drainage water were discharged into the reservoir. Since 1981, the FWS has observed only mosquito fish in the reservoir; however, several varieties of fish were in the drain as recently as 1983.

In laboratory analyses done in 1982, the FWS found that selenium concentrations in fish taken from the San Luis Drain and Kesterson Reservoir were as much as 100 times higher than the concentrations in fish from the nearby Volta Wildlife Management Area. Subsequent field observations at the

WATERFOWL-RELATED PATTERNS IN THE GRASSLANDS AREA

Influx of migratory waterfowl

Pattern	Start Month	End Month
Influx of migratory waterfowl	Sept	Apr
Flooding of grasslands	Oct	Feb
Hunting season	Nov	Jan
Flooding of Kesterson Reservoir	Dec	Aug
Nesting period	Apr	Jul

Flooding of grasslands

Hunting season

Flooding of Kesterson Reservoir

Nesting period

Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug

The greatest risk of waterfowl exposure to selenium in drainage water in Kesterson Reservoir is in late winter and early spring (after the waterfowl hunting season). During this period the reservoir provides one of the few large habitat areas available to waterfowl in the San Joaquin Valley.

reservoir in the spring of 1983 showed very high incidences of mortality and deformities among newborn coots, grebes, stilts, and ducks. Concentrations of selenium in adult birds were high, although the FWS observed no mortalities.

In 1984, grebe, stilt, and duck populations using the reservoir for nesting remained at about the 1983 levels. The FWS observed no coot nests, however, and found a large number of dead coots throughout the reservoir area. The FWS has identified selenium poisoning as the cause of death of adult birds, and the most likely cause of chick and embryo deformities.

Selenium biologically concentrates as it moves through the food chains leading to birds. At the lower end of the food chain, selenium accumulates in small fish, insects, and plants grown in Kesterson Reservoir; thus, the FWS believes that the food eaten by birds is the main source of selenium in adult birds. This selenium is also transferred from adult birds to their eggs.

The FWS found the highest levels of selenium measured in any of the waterfowl at Kesterson Reservoir in resident adult coots. Although coots are not a highly desirable game bird, hunters seek them when other game birds are less plentiful. Some scientists and members of the public

fear that high concentrations of selenium in birds could pose a health hazard to people who eat the birds. In December 1983, the DFG posted a warning at Kesterson Reservoir to caution hunters to limit their consumption of coots.

Some waterfowl nest at Kesterson Reservoir, but not in large numbers. The effect of the brief exposure of migratory birds to the drainage water or food grown in the reservoir is unknown. However, to protect against any health hazard associated with eating game birds, the FWS has closed Kesterson Reservoir to hunting for the 1984-85 season. In addition, as a precaution the California Department of Health Services has recommended that people limit their consumption of ducks taken from the Kesterson National Wildlife Refuge area and the grasslands area. In a news release issued October 18, 1984, the DFG relayed the Health Services Department's recommendation that pregnant women and children under 10 not eat ducks from the area. Other people should not eat more than one meal of duck from the area each week, and not eat duck livers, which concentrate selenium.

HOW CAN THE PROBLEM BE SOLVED?

There are two possible ways to permanently solve the waterfowl problem at Kesterson Reservoir: (1) Stop irrigating the land that contributes selenium to drainage water feeding into the reservoir, or (2) provide adequate and environmentally safe drainage disposal facilities to serve the land. These are also the basic choices available to solve the larger salt management and drainage problem affecting the west side of the San Joaquin Valley.

The FWS, GS, and the Bureau are working with other governmental agencies and experts from the private sector to determine the necessary studies on selenium and other trace elements. The agencies have started some studies and will start others soon. Studies will describe existing water-quality conditions and forecast conditions expected to occur with continued irrigation. Other studies are designed to determine the toxic effects of trace elements, including selenium, on fish and wildlife, and what the acceptable safe levels for each element must be.

Until a long-term solution can be developed, the FWS and the Bureau have instituted interim measures to keep waterfowl from using Kesterson Reservoir. These measures will, in turn, help safeguard the public from any

potential health hazard that could result from people eating birds exposed to drainage water in the reservoir.

The immediate need is to confine water containing selenium to as small an area in Kesterson Reservoir as possible, thereby minimizing waterfowl exposure to the selenium. The most difficult time to reduce exposure by this method is February through early April, when the reservoir provides one of the few large habitat areas available to waterfowl in the San Joaquin Valley. Other, more attractive habitats are available from October until February, when the grasslands area is flooded to attract waterfowl for hunting.

Discharges into Kesterson Reservoir are greatest during the late winter, spring, and early summer, and taper off in late summer and fall. During the periods when most of the reservoir ponds are flooded, other waterfowl habitat is less plentiful. There is always some permanent marsh at the reservoir.

WHAT IS BEING DONE TO SOLVE THE PROBLEM?

The FWS and the Bureau have initiated a waterfowl protection program at Kesterson Reservoir to reduce the exposure of waterfowl to drainage water containing selenium.

The waterfowl protection program has three parts: (1) Operation of the reservoir to make it as unattractive as possible to waterfowl, (2) a hazing program to frighten birds away from the reservoir, and (3) improvement of existing, nearby habitat to attract waterfowl away from the reservoir.

The FWS began the hazing program in mid-September and plans to continue it through March 1985. Scarecrows, propane exploders, and fireworks such as whistle bombs and shellcrackers are being used to frighten waterfowl and discourage their use of the reservoir. Farmers and airport managers commonly use these methods to keep birds away from crops and clear of runways.

The presence of workers using and servicing the hazing devices will also help keep the birds away. The FWS will employ 6 to 9 people to provide around-the-clock coverage. Workers will continuously monitor activities to determine waterfowl use of the reservoir, waterfowl responses to the hazing, and changes needed to improve the program.

The Bureau will operate Kesterson Reservoir to complement the hazing program. To the extent possible, the Bureau will confine water storage to the ponds on the east side of the reservoir. Deep flooding of the ponds will discourage bottom feeding by waterfowl. The hazing activities at these ponds should not directly disturb hunting on the private duck clubs to the west and south of the reservoir. Maximum flooding will be from January to April, when all of the reservoir ponds are normally flooded.

To offset the loss of habitat to birds displaced from Kesterson Reservoir, the Bureau will provide a water supply of approximately 15,000 acre-feet to improve existing, nearby habitat. The Bureau will deliver water from the Delta-Mendota Canal to the Mendota Pool, where the San Luis Canal Company and the Central California Irrigation District, respectively, will convey it to the San Luis National Wildlife Refuge and Grassland Water District. The Bureau will also deliver water to the DFG for use at the Volta Wildlife Management Area. Grassland Water District will provide approximately 4,000 acre-feet of irrigation return flow to the DFG for use at the Los Banos Wildlife Management Area.

The Bureau will deliver water to the alternative habitat areas between late October 1984 and March 1985, to coincide with the peak

waterfowl migrations into the area, draining of private duck clubs and refuge lands, and extensive flooding of Kesterson Reservoir. Grassland Water District will provide return flow for use at Volta from late January through March 1985. These waters will improve habitat on about 20,000 acres of private lands in the southern part of Grassland Water District and about 5,000 acres of public, wildlife refuge lands.

The waterfowl protection program will minimize waterfowl use of Kesterson Reservoir, but will eliminate public hunting and other recreational opportunities at the reservoir and may reduce waterfowl use on adjacent lands.

Westlands Water District, the only contributor of subsurface water to the drain, is reviewing its irrigation practices to identify ways to reduce drainage discharges into Kesterson Reservoir during the next growing season. Federal, State, and county agencies are monitoring domestic water supplies in the Kesterson vicinity for selenium and other trace elements, and the Bureau has asked the California Department of Food and Agriculture to expand an ongoing monitoring program to measure selenium levels in commercial food and forage crops and beef and dairy cattle in the drainage service area.

The Bureau also has asked the Environmental Protection Agency to monitor air quality around Kesterson Reservoir and along the San Luis Drain to determine if selenium is present in the atmosphere. However, because selenium in its gaseous form is very unstable, air quality experts believe it is unlikely that selenium in the air is a problem in the Kesterson area. Field crews working in the reservoir area wear protective clothing as a precautionary measure, and their blood and urine levels of selenium are being monitored.

The Bureau and the FWS are considering additional measures to resolve the waterfowl problem at Kesterson Reservoir until the best long-term solution can be developed. These measures include: (1) Removing the reservoir vegetation and fish and other aquatic animals that birds feed on, (2) reducing drainage discharges into the reservoir, (3) creating a buffer zone around the reservoir to protect wildlife, and (4) stopping irrigation water deliveries to the drainage problem area.

Removing the plants and aquatic life in Kesterson Reservoir that birds feed on would reduce or eliminate the accumulation of high concentrations of selenium in waterfowl. The Bureau and the FWS could drain some or all

of the ponds, remove the vegetation, and manage the drained ponds to prevent revegetation. The agencies could periodically treat the water in any remaining ponds to remove fish and other aquatic life.

The Bureau has identified three ways to reduce drainage discharges into Kesterson Reservoir: (1) Reduce or reschedule irrigation of lands, (2) curtail water deliveries to Westlands Water District, and (3) plug existing collector drains to cut off drainage flows. These measures could be combined. All of them, however, would increase farm costs, further degrade farmlands, and reduce agricultural productivity. Plugging the collector drains without curtailing irrigation would allow subsurface drainage to rise to the land surface in some areas. The water would turn some land into a marshy area, and if there were high selenium concentrations in the water and vegetation it could result in waterfowl problems similar to those at Kesterson Reservoir.

Another possibility to protect waterfowl is to create a "buffer zone" around Kesterson Reservoir to discourage waterfowl use. The Bureau could purchase a strip of land around the reservoir, clear the vegetation to discourage wildlife use, and fence the area to keep livestock out. For the buffer zone to be effective, the Bureau would also have to remove vegetation from the reservoir to discourage birds from feeding and nesting.

The most far-reaching measure would be to stop water deliveries to the San Joaquin Valley areas that contribute high levels of contaminants to drainage water. Along with this measure the Bureau could plug the existing field collector drains to cut off discharges into the existing San Luis Drain and Kesterson Reservoir, allow the water in the reservoir to evaporate, remove the vegetation, and manage the reservoir area to prevent revegetation.

Without irrigation water and drainage facilities, land in the problem area could not be farmed. Affected farmers would most likely go out of business, service industries and the local tax base would decline, unemployment and the demand for public assistance would rise, and some people would have to leave the area to find work. These local effects would in turn be felt on a smaller scale in the regional and State economies, which also are closely tied to agriculture.

Several combinations of these additional measures are possible. The Bureau and FWS are studying them now to determine which ones are the most feasible and practicable.

WHERE CAN YOU GET MORE INFORMATION?

We want to know your views about solving the waterfowl problems at Kesterson Reservoir and the salt management and drainage problems affecting the San Joaquin Valley. Workshops will be held in late November to discuss the drainage problems, new technical studies being made for the San Luis Unit Special Study, and drainage alternatives being evaluated.

We will keep you informed about the waterfowl protection program and other measures being taken to resolve the problems at Kesterson Reservoir. In the meantime, please write to us if you have any questions or comments.



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FEEDBACK

Thank you for taking the time to read this information bulletin. We expect to develop additional bulletins in the near future which will address specific issues and concerns as an aid to informed public decisions on alternative drainage and salt management solutions.

Previous bulletins in this series were: Information Bulletin 1 on Drainage and Salt Disposal (January 1984), Bulletin 2 on Kesterson Reservoir and Waterfowl (February 1984), and Bulletin 3 on the Status of the San Luis Unit Special Study (August 1984).

We would appreciate your reaction to this bulletin (number 4) and how we can make the public information component of the San Luis Unit Special Study most responsive to your desires and needs. Please take time to answer the questions below and return this sheet to us.

Thank you.

(Please print or type)

This bulletin (number 4) is:

☐ highly informative

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Would you like to continue receiving the periodic bulletins on the San Luis Unit Special Study?

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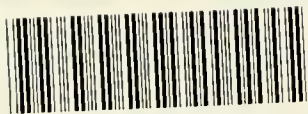
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